Research and Development of Manufacturing Technology Improvement for Advanced Uncooled Infrared Focal Plane Arrays

Industry Day

BAA 03-04-FH

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Agenda

• Introduction	Dr A Fenner Milton
• UCIR FPA ManTech Goals/ Operational Issues/ Future Focus	Jim Brown
• Procurement Process	Jane Bourne/DOI

UCIR ManTech Goals & Objectives

- Improve availability of small pixel UCIR FPAs
  - 100 packaged UCIR FPAs/week/source
  - Anticipate requirements of > 12,000 UCIR FPAs/year by FY07
- Emphasis placed on 640x480 UCIR FPAs
  - 320x240, small pixel UCIR FPAs also improved
- Reduce costs of packaged UCIR FPAs
  - 8X reduction in current costs
- Program duration: FY03 through FY06

UCIR ManTech Goals & Objectives

AUCIR FPA ManTech Goals				
METRICS	Baseline	4th QTR, FY04	4th QTR, FY05	4th QTR, FY06
Design resistance deviation				±7%
Resistance Nouniformity				<7% p-p
FPA Yield*				> 50%
Package yield				> 98%
ManHours/unit**				1.2 hrs/unit
Cycle time				4 wks
Vacuum Life				10 yrs @ CFI
Performance				< 35 mK
Cost				$2 K/unit***
* Measured in accordance with production specification				
** Time required to fabricate, vacuum package, calibrate, and test unit after receipt of ROIC wafer				
*** At 100 units/week production rate				

UCIR ManTech Goals & Objectives

Program measures of yield are evaluated against this FPA and vacuum package production specification:

1. Array format	**640x480**
2. Full Frame Rate	**30 Hz (required) 60 Hz (desired)**
3. F/#	**F/1**
4. Time constant	**< 12 ms**
5. Pixel pitch	**25.2 ± 0.2 microns**
7. NEDT @ F/1.0, 300K, $\lambda_{cut\text{-}on}$	**< 35 mK**
8. $\lambda_{cut\text{-}on}$	**$\geq$ 8 microns**
9. Dynamic Range	**>78 dB**
10. Operating ambient temp	**233K to 333K**
11. Power at 30 Hz Active:	**CFI**
12. Defects	**CFI**
12.1. Row and column	**Zero**
12.2.1. Single pixel	**CFI**
12.3. Cluster Defects	**CFI**
12. Reliability/Vacuum life	**10 years @ CFI**

UCIR FPA ManTech Clarifications

- **Delete Interface Requirements (Table 2) in PIP**

- **CFI defect specification in Table 1 will become common for all**
  - **Tiered (different quality) defect specifications requested with operational justification**

UCIR ManTech Proposal Suggestions

- Technical proposals shall specifically provide for clear milestones at the end of each fiscal year with each such milestone specifically stating the work or effort to be completed and the cost of such work or effort.

- Each such milestone shall be considered a divisible part of the contract.

- Within each such milestone, there shall be a further division of specifically stated tasks and the cost for each such task.

- Each such task shall be a divisible part of the contract.

- Cost sharing is encouraged
  - Contractors may propose retaining residual FPAs

- Prioritization of all tasks in terms of largest return on investment

UCIR ManTech Program Deliverables

- Recommend 3 industry wide program reviews (4th qtr, 04, and annually thereafter) at RDECOM CERDEC NVESD (Ft Belvoir)
- Other program reviews at contractor facilities

- Wafer lots (640x480):
  - First lot and/or existing data to establish baseline
  - 15 subsequent wafer lots (six 6” wafers/lot) minimum
- Deliverables to Government:
  - 4 units from each of last two lots (8 Units)
  - 2 units from lot 3, lot 6, lot 9, lot 12 (8 units)
  - Interface electronics for laboratory imaging of intermediate units
  - System’s (2) demo funded through the program, not GFE
    - No systems specs – demonstrate FPA performance
    - Laboratory demonstration at contractor’s facilities

Uncooled VOx 640x480 Status

- <30 mK NETD measured
- Further NETD Improvements Expected
  - Analysis predicts 20 mK can be achieved

- Sponsor: US Army RDECOM CERDEC NVESD
  - Science & Technology Division

✓ TV equivalent resolution of 640 x 480
✓ Better than 1St Gen FLIR performance without cryogenic cooler
✓ Small detector pitch
✓ High Sensitivity
✓ Low Power - 2.5 Watts

Uncooled 640x480 Image
4.6º x 6.1º FOV

Raytheon PAM Demonstrator
(320x240, 25 micron)

10 ms Thermal Time Constant

Mid Range Munition
(MRM) for FCS Block I

RDECOM CERDEC NVESD Applied Research Programs

- New FY04 6.2 STO (Low Cost High Resolution IR FPAs) developing very large format, Uncooled IR FPAs with 5 ms time constant and < 20 mK NETD
  - AMRDEC analysis suggests required time constant for PAM Blk II, LAM Blk II, Common Missile is 5 – 10 ms & formats as high as 1920x2560
  - Current PAM uses 320x240, small pixel Uncooled IR FPA
    - Time constant of PAM Blk I Uncooled IR FPA is ≈10 ms
    - Developed under CERDEC NVESD DUAP 98 program

Raytheon PAM Demonstrator

Short time constant required for missile seeker applications

- FY03 6.2 STO (Low Cost Counter Reconnaissance Technology) developing reduced signature Uncooled IR sensors to reduce detection probabilities
  - New FPAs & optics components for hardened Uncooled IR cameras
  - Uncooled IR sensor signature reduction by factor of 1000 (TRL 3 →TRL 5 by FY06)
  - cost goal: OI/OA mods < 10 % of total UCIR camera cost in production

Significant S&T required to reduce Uncooled IR FPA time constant and reduce IR sensor optical cross section

Summary

- **Uncooled FPA Producibility program concentrates on 640x480, nominal 1 mil pixel**
- **Request prioritization of separately priced tasks**
- **Expect awards within FY03**